

Science Software Integration and Test Procedures for the MODIS Instrument at the GSFC DAAC



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**Science Software Integration and
Test Procedures for the MODIS
Instrument at the GSFC DAAC**

Original Signature page on file in the Configuration Manager's Office.

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Change Record Page

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Science Software Integration and Test Procedures for the MODIS Instrument at the GSFC DAAC

1. INTRODUCTION

This document details the Science Software Integration and Test (SSI&T) Procedures for the Moderate Resolution Imaging Spectroradiometer (MODIS) Instrument at the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC). The MODIS Science Data Support Team (SDST) shall deliver three major releases (Beta, Version 1 [V1], and Version 2 [V2]) of the MODIS Science Data Processing Software (SDP S/W) to the GSFC DAAC. These releases shall occur at approximately one-year intervals with the Beta Release scheduled for January 1996. The overall plan for carrying out a MODIS SDST SDP S/W delivery to the GSFC DAAC will be modified as necessary depending on the version being delivered. The exact details of SSI&T for each release is captured in the SSI&T step matrix discussed later in this document.

As such, this document serves as an agreement between the GSFC DAAC and the MODIS Instrument Team (IT) only. As releases are made and the processes are refined, this document shall be updated in an iterative fashion. Changes to the document are effected by agreement between the GSFC DAAC Manager and the SDST Manager. Once both parties agree to proposed changes, the actual updates are carried out by support staff on the SDST General Sciences Corporation (GSC) contract. The current copy is available by request from the MODIS SDST Configuration Management Officer (CMO). This document does not require the signature of any representative(s) of the Earth Science Data and Information System (ESDIS) Project.

1.1 Purpose

The purpose of this document is to fully describe the plans and procedures and the roles and responsibilities governing SSI&T between the GSFC DAAC and the MODIS IT for the Beta, V1, and V2 deliveries of the SDP S/W. This is a living document which is expected to be modified based upon lessons learned in the SSI&T process associated with early science software deliveries.

1.2 Scope

This document describes in detail the planned scenario for the specific SSI&T process between the GSFC DAAC and the MODIS IT. The specific plans, procedures, roles, and responsibilities outlined in this document shall take precedence over the documents listed in Section 1.4 in event of a conflict.

1.3 Content and Structure

This document has been organized into the following sections:

- Section 1 provides the background and introduction to this document .
- Section 2 identifies the activities used during the SDP S/W delivery from the MODIS SDST to the GSFC DAAC, including the work carried out by SDST at the DAAC prior to formal delivery.
- Section 3 identifies the activities at the DAAC following the receipt of the SDST SDP S/W delivery.
- Section 4 describes the build and test process used by the DAAC after formal acceptance of the SDST SDP S/W delivery.
- Section 5 describes the policies governing delta deliveries between the planned Beta, VI, and V2 deliveries, where a delta delivery is provided in order to correct problems discovered in acceptance and/or operations testing, or to incorporate science software received after the original delivery date.
- Section 6 defines how regression testing shall be carried out from one delivery to the next.
- Appendix A identifies the acronyms and abbreviations.
- Appendices B, C, and D contain the detailed SSI&T step matrixes for carrying out the delivery processes for each release.

1.4 Relevant Documents

The following documents are relevant to the overall SSI&T process and provide detailed definitions of MODIS SSI&T procedures, scenarios, and philosophy:

- ESDIS Project Data Production Software and Science Computing Facility Standards and Guidelines; 423-16-01.
- Interface Control Document (ICD) between ECS and SCF; 209-CD-005-001.
- Software Developer's Guide to Preparation, Delivery, Integration and Test with ECS, January 1995; 205-CD-002-001.
- Operations Concept for Integration and Test of Science Data Production Software (White Paper), document number 162-WP-001-002.
- Science Data Processing Segment Integration and Test Plan for the ECS Project, Volume 1: IR1; 319-CD-002-001.
- MODIS Software Management Plan; August 1995; SDST-002.
- MODIS SDST Quality Assurance Plan, June 30, 1995, SDST-003.
- MODIS SDST Configuration Management Plan, June 30, 1995; SDST-004.
- MODIS Beta System Test Plan, August 1995; SDST-005.
- MODIS Data Management Plan, August 1995; SDST-006.
- MODIS Beta Requirements Specification, August 1995; SDST-020.
- MODIS Software Development Standards and Guidelines, February 15, 1995; SDST-022.

2. SCIENCE SOFTWARE DELIVERY

The MODIS SDST shall deliver three releases (Beta, V1, and V2) of the MODIS SDP S/W to the GSFC DAAC. Each release shall begin integration and test at the DAAC after completion of the DAAC's hardware acceptance process. Delivery activities carried out by the SDST for each release are discussed below. The discussions are drawn from the detailed step matrix for each release, which are provided in Appendix B (Beta SSI&T Step Matrix), Appendix C (V1 SSI&T Step Matrix), and Appendix D (V2 SSI&T Step Matrix).

2.1 Science Data Processing Software Beta Release

The goals for the SDST with the Beta Release are to:

- Test the migration from the MODIS Team Leader Computer Facilitating (TLCF) to the GSFC DAAC
- Exercise program interfaces to at least Version 5 of the Science Data Production Toolkit (SDPTK)
- Test the execution of the prototype science software in the SDP environment.

The Beta Release is not guaranteed to contain all the science software and may not consume realistic levels of computational resources.

The goals of the GSFC DAAC for the Beta delivery of the science software are to:

- Demonstrate the portability of the science software delivered from the TLCF through adherence to the ESDIS Project Data Production Software and Science Computing Facility Standards and Guidelines;
- Exercise, verify and update SSI&T procedures (including problem tracking and problem resolution);
- Exercise and verify program interfaces to the DAAC installation of the SDPTK.

The DAAC will seek to successfully repeat the steps taken by the SDST for integrating the SDP S/W with the DAAC installation of the SDPTK, and to run the delivered science software to normal completion repeatedly over the range of data inputs within the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) Interim Release-1 Science Data Processing Subsystem.

A joint goal for the SDST and the GSFC DAAC is a 'lessons learned' assessment of the software integration process after the Beta SSI&T is completed. The knowledge gained will be used to refine the delivery processes and procedures and update this document.

2.1.1 Delivery Planning and Notification

The timely execution of the SSI&T procedures are dependent on the overall progress of the Earth Observing System (EOS) Program as a whole. The ESDIS Project, as overall program management, and Hughes Applied Information Systems, as the hardware system procurers, are responsible for delivering to the GSFC DAAC the hardware environment that will host the Beta, V1, and V2 SDP S/W releases. Within

that context, the SDST and the DAAC teams each have a responsibility to maintain their respective schedules for the SSI&T process. If a slip occurs in the baseline schedule that affects planned SDP S/W delivery dates, the SDST Manager shall notify the DAAC SSI&T Manager. Similarly, the DAAC maintains the schedule for the DAAC hardware integration and checkout, overall DAAC work load, and readiness date for receiving the Beta Release. If a slip occurs in the baseline schedule that affects the DAAC's readiness to receive the Beta Release, the DAAC SSI&T Manager shall notify the SDST Manager.

The delivery process from the MODIS TLCF to the GSFC DAAC is initiated by a Plan Operations Support Request e-mail from the MODIS SDST Reliability and Quality Assurance (R&QA) Manager to the DAAC SSI&T Manager. The e-mail shall contain a request for a user account on the test hardware and the final version of the Beta Development Test Plan. It shall be issued at least 14 calendar days prior to the planned delivery date. The Beta Development Test Plan shall include information on: which software modules are included in the release; the proposed schedule of activities in the DAAC; the level of staff support expected from the ECS/DAAC team; and the estimated resource utilization (I/O, disk space, Central Processing Unit [CPU] cycles) of the DAAC computer systems. The SDST R&QA Manager will be notified by the DAAC SSI&T Manager of an assessment/approval of MODIS's stated intentions and requirements within seven calendar days of receipt of the Beta Development Test Plan.

2.1.2 Anticipated Support/Staffing Requirements

The Beta Release of the MODIS SDST SDP S/W requires support from both the SDST and DAAC teams for success. SDST plans to provide three and a half full-time people during the anticipated one month infusion period from March 1 to March 31, 1995. The personnel involved include the SDST Integration Lead for the Beta Release (full time), a script analyst (full time), a test engineer (full time), and parts of the CMO and software development team (accounting for half a full time equivalent).

The GSFC DAAC plans to provide the equivalent of four and a half full-time positions in support of the Beta SSI&T. These personnel include a System Administrator (full-time), Production/Data Specialist (full-time), Algorithm Tech Support (full-time), Operations Supervisor (part-time), and a DAAC CMO (part-time).

The ECS personnel with expertise on the implementation of SDPTK, metadata, ancillary data, and ECS system should be on-call to resolve any problems encountered during integration.

2.1.3 Size and Scope of Delivery

The current estimate of the size of the Beta Release is 210,000 lines of code. Of this delivery, approximately 190,000 lines of code will be Level 2 (L2) and Level 3 (L3) science software developed by the Science Team Members (STMs). The remainder will be Level 1A (L1A), Level 1B (L1B), geolocation, and utility software written by the SDST and the MODIS Characterization Support Team (MCST). Where L3 land products are needed to run L2 products (such as Bi-directional Reflectance Distribution Function [BRDF]), either the L3 product shall be executed directly in the GSFC DAAC for the Beta Release only, or simulated data shall be substituted.

2.1.4 Scenario Model for Software Delivery and Science Software Integration and Test

The scenario model planned for SSI&T activities in the DAAC follows the infusion method described in the Operations Concept for Integration and Test of SDP S/W document. The infusion method assumes that the SDP S/W release is initially transferred to an investigator work area in the DAAC computing environment. The SDST conducts testing to ensure that the software functionality in the DAAC is the same as the functionality previously baselined in the MODIS TLCF. SDST leads this effort with support from the DAAC team. After a Software Acceptance Review led by the DAAC, the software is turned over to the DAAC team and they assume responsibility for Configuration Management (CM) and production operations for that release.

2.1.5 Minimum Documentation Requirements for the Delivery

The goal of the documentation delivered with the Beta Release is to verify that the content, format, and process for providing the delivery information satisfies the needs of both the SDST and the DAAC. It serves as a rehearsal for the V1 and V2 Release documentation packages. The SDST shall provide to the GSFC DAAC a System Description Document, an Operations Manual, a Processing Files Description Document, and Beta Release Test Plan. The information in each document shall follow the table of contents specified in Appendix C of the Software Developer's Guide to Preparation, Delivery, Integration and Test with ECS document with the following exceptions.

The System Description Document will not include information describing the scientific or Quality Assurance (QA) aspects of the output data products, nor will it include information on the nominal system performance associated with each Product Generation Executive (PGE). The Operations Manual shall not include any information concerning instrument reflight instructions.

The timeline for the release of the draft and baseline versions of each document are four months and two months prior to the delivery of the Beta Release.

2.1.6 Delivery Package Transfer Methodology

The delivery of the software release to the DAAC shall consist of two things: a delivery message sent via e-mail to the DAAC describing the contents of the delivery, and a UNIX tar file loaded into the directory specified by the DAAC. The MODIS CMO shall transfer the delivery from the MODIS TLCF to the destination directory in the DAAC. The delivery message shall be a text file that describes the MODIS TLCF as the source of the release, lists the source files, details the configuration control processes used to create the delivery, and provides the installation and build procedures. The delivery memo shall list the sizes of the uncompressed files, the toolkit interfaces used by the release, and the utility libraries the release needs in the DAAC computing environment. The detailed contents of the delivery memo are specified in Section 6.3.1, The Delivery Memo, in the January 1995 edition of the Data Item Description 205-CD-002-001.

2.2 Science Data Processing Software Version 1 Release

The goals for the SDST for the V1 Release are to demonstrate all major functional capabilities of the science software, i.e. all required inputs are read in (including ancillary and metadata) and all required outputs are created. The corresponding step matrix for V1, updated to reflect lesson learned from the Beta Release, is identified in Appendix C. A complete operator interface will be in place, including the generation of all planned messages using standard error and message logging services provided by the SDP. Realistic levels of computational resources will be consumed in the production of each MODIS science product.

In addition to the SSI&T goals stated for the Beta delivery of the science software, the goals of the GSFC DAAC for the V1 Release of the science software include: verifying that the SDP S/W runs without interfering with other DAAC operations; refining the delivery and SSI&T processes, defining organizational responsibilities and support and use of SSI&T tools; determining an initial estimate of the production resource requirements for the SDP S/W (e.g., CPU time, memory, staging space, etc.); testing internal interfaces to other system elements (Communications and System Management Segment [CSMS]) and external interfaces to the Science Computing Facility (SCF) (log files, data QA procedures, etc.).

2.2.1 Delivery Planning and Notification

The SDST and the DAAC teams each have a responsibility to maintain their respective schedules for the SSI&T process. The SDST maintains the SDP S/W development schedules. If a slip occurs in the baselined schedule that affects planned SDP S/W delivery dates, the SDST Systems Analyst shall notify the DAAC SSI&T Manager. Similarly, the DAAC maintains the schedule for the DAAC hardware integration and checkout, overall DAAC work load, and readiness date for receiving the V1 Release. If a slip occurs in the baselined schedule that affects the DAAC's readiness to receive the V1 Release, the DAAC SSI&T Manager shall notify the SDST Manager.

2.2.2 Anticipated Support/Staffing Requirements

The V1 Release of the MODIS SDST SDP S/W requires support from both the SDST and DAAC teams for success. The anticipated level of staffing shall be similar to that provided for the Beta Release, i.e. eight full-time personnel. The actual staffing profile shall be finalized several months prior to the V1 Release. SDST plans to provide three and a half full-time personnel during an anticipated three month infusion period. The personnel involved include the SDST Integration Lead for the V1 Release (full time), a script analyst (full time), a test engineer (full time), and parts of the CMO and software development team (accounting for half a full time equivalent).

The GSFC DAAC plans to provide the equivalent of four and a half full-time positions in support of the Beta SSI&T. These personnel include a System Administrator (full-time), Production/Data Specialist (full-time), Algorithm Tech Support (full-time), Operations Supervisor (part-time), and a DAAC CMO (part-time).

The ECS personnel with expertise on the implementation of the SDP Toolkit, metadata, and ancillary data should be on call to resolve any problems encountered during integration.

2.2.3 Size and Scope of Delivery

The current estimate of the size of the V1 Release is 300,000 lines of code. Of this delivery, the majority of the code will be L2, L3, and Level 4 (L4) science software developed by the STMs. The remainder will be L1A, L1B, geolocation, and utility software written by the SDST and the MCST.

2.2.4 Scenario Model for Software Delivery and Science Software Integration and Test

The scenario model planned for SSI&T activities in the DAAC follows the infusion method described in the Operations Concept for Integration and Test of SDP S/W document. This decision shall be revisited in May 1996 as part of the 'lessons learned' review from the Beta SSI&T process. Infusion assumes that the SDP S/W release is initially transferred to an investigator work area in the DAAC computing environment. The SDST carries out testing to ensure that the software functionality in the DAAC is the same as the functionality previously baselined in the MODIS TLCF. The SDST leads this effort with support from the DAAC team.

2.2.5 Minimum Documentation Requirements for the Delivery

The SDST shall provide to the GSFC DAAC a System Description Document, an Operations Manual, a Processing Files Description Document, and V1 Release Test Plans. The information in each document shall follow the table of contents specified in Appendix C of the Software Developer's Guide to Preparation, Delivery, Integration and Test with ECS document with certain exceptions. The Operations Manual shall not include any information concerning instrument reflight instructions.

The timeline for the release of the draft and baseline versions of each document are four months and two months prior to the delivery of the V1 Release.

2.2.6 Delivery Package Transfer Methodology

The delivery of the software release to the DAAC shall consist of two things: a delivery message sent via e-mail to the DAAC describing the contents of the delivery, and a tar file loaded into the directory specified by the DAAC. The MODIS CMO shall transfer the delivery from the MODIS TLCF to the destination directory in the DAAC. The delivery message shall be a text file that describes the MODIS TLCF as the source of the release, lists the source files, details the configuration control processes used to create the delivery, and provides the installation and build procedures. The delivery memo shall list the sizes of the uncompressed files, the toolkit interfaces used by the release, and the utility libraries the release needs in the DAAC computing environment.

2.3 Science Data Processing Software Version 2 Release

The goals for the SDST for the V2 MODIS Software release are to field a tested, verified system that is launch-ready, provides scientifically meaningful output, is fully operational in the SDP environment, and provides a full documentation suite (including System Description Documents, Operator's Manual, Processing Files Description Document and Test Plans). The corresponding step matrix for V2, updated to reflect lesson learned from the V1 Release, is identified in Appendix D. In addition

to the goals of the MODIS SDST, the goals for the GSFC DAAC for the V2 Release are to:

- Establish as a baseline a complete, verified MODIS Science Data processing system that will support operational post-launch data processing.
- Have a MODIS SDPS that will run efficiently in the DAAC environment with robust error handling.
- Have a fully documented system MODIS SDPS.
- Provide training to DAAC operations staff on the running the MODIS SDPS.

2.3.1 Delivery Planning and Notification

The SDST and the DAAC teams each have a responsibility to maintain their respective schedules for the SSI&T process. The SDST maintains the SDP S/W development schedules. If a slip occurs in the baselined schedule that affects planned SDP S/W delivery dates, the SDST Manager and the SDST Systems Analyst shall notify the DAAC SSI&T Manager. Similarly, the DAAC maintains the schedule for the DAAC hardware integration and checkout, overall DAAC work load, and readiness date for receiving the V2 Release. If a slip occurs in the baselined schedule that affects the DAAC's readiness to receive the V2 Release, the DAAC SSI&T Manager shall notify the SDST Manager.

2.3.2 Anticipated Support/Staffing Requirements

The V2 Release of the MODIS SDST SDP S/W requires support from both the SDST and DAAC teams for success. The anticipated level of staffing shall be similar to that provided for the Beta Release, i.e. eight full-time personnel. The actual staffing profile shall be finalized several months prior to the V2 Release. SDST plans to provide three and a half full-time personnel during an anticipated three month infusion period. The personnel involved include the SDST Integration Lead for the V2 Release (full time), a script analyst (full time), a test engineer (full time), and parts of the CMO and software development team (accounting for half a full time equivalent).

The GSFC DAAC plans to provide the equivalent of four and a half full-time positions in support of the Beta SSI&T. These personnel include a System Administrator (full-time), Production/Data Specialist (full-time), Algorithm Tech Support (full-time), Operations Supervisor (part-time), and a DAAC CMO (part-time).

The ECS personnel with expertise on the implementation of the SDP Toolkit and ECS system should be on call to resolve any problems encountered during integration.

2.3.3 Size and Scope of Delivery

The current estimate of the size of the V2 Release is 400,000 lines of code. Of this delivery, approximately 100,000 lines of code will be L2, L3, and L4 science software developed by the STMs. The remainder will be L1A, L1B, geolocation, and utility software written by the SDST and the MCST.

2.3.4 Scenario Model for Software Delivery and Science Software Integration and Test

The scenario model planned for SSI&T activities in the DAAC follows the infusion method described in the Operations Concept for Integration and Test of SDP S/W document. This decision shall be revisited in late 1997 as part of the 'lessons learned' review from the V1 SSI&T process. Infusion assumes that the SDP S/W release is initially transferred to an investigator work area in the DAAC computing environment. The SDST carries out testing to ensure that the software functionality in the DAAC is the same as the functionality previously baselined in the MODIS TLCF. The SDST leads this effort with support from the DAAC team.

2.3.5 Minimum Documentation Requirements for the Delivery

The SDST shall provide to the GSFC DAAC a System Description Document, an Operations Manual, a Processing Files Description Document, and V2 Release Test Plans. The information in each document shall follow the table of contents specified in Appendix C of the Software Developer's Guide to Preparation, Delivery, Integration and Test with ECS document.

The timeline for the release of the draft and baseline versions of each document are four months and two months prior to the delivery of the V2 Release.

2.3.6 Delivery Package Transfer Methodology

The delivery of the software release to the DAAC shall consist of two things: a delivery message sent via e-mail to the DAAC describing the contents of the delivery, and a Tar file loaded into the directory specified by the DAAC. The MODIS CMO shall transfer the delivery from the MODIS TLCF to the destination directory in the DAAC. The delivery message shall be a text file that describes the MODIS TLCF as the source of the release, lists the source files, details the configuration control processes used to create the delivery, and provides the installation and build procedures. The delivery memo shall list the sizes of the uncompressed files, the toolkit interfaces used by the release, and the utility libraries the release needs in the DAAC computing environment.

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3. PRELIMINARY ACTIVITIES AT THE DAAC

Prior to the start of the SSI&T the MODIS R&QA Manager will send an Operations Support Request to the DAAC SSI&T Manager via e-mail. This request should indicate that a user account is requested on the test hardware to permit an informal transfer of the SDP S/W and identify the start of the infusion process. Information on the disk space and directory permission requirements should also be provided. The DAAC will respond via e-mail acknowledging receipt of the request message, approval of the request, user account information and other information regarding the Investigator Directory created to support initial Integration and Testing (I&T) of the SDP S/W by the SDST at the DAAC. The SDST CMO will transfer the SDP S/W into the Investigator Directory at the DAAC.

3.1 Instrument Team Lead Activities

The DAAC will setup account(s), assign adequate disk space and permissions, and provide access to appropriate libraries for the SDST on the appropriate SSI&T platforms prior to the software delivery to the DAAC from the SDST. This information will be conveyed to the SDST prior to the initial software delivery. The ECS DAAC System Administrator will serve as the point of contact for this information within the DAAC. The MODIS SDST Integration Lead will serve as the point of contact for this information within the SDST.

The DAAC will provide remote access as ECS security allows, as well as on-site access to the SSI&T environment to SDST staff.

3.2 Receipt of the Delivery Package

After the Delivery Package is received at the DAAC the following steps are followed:

- The DAAC sends an acknowledgment of receipt to the MODIS SDP S/W Manager.
- The delivery package is then uncompressed and files are extracted from a tar file.
- A delivery memo is read and the delivery package contents are checked against a file inventory. Documentation files are checked to verify that the contents are identical to what is stated in file labels.
- Data files are cursorily checked by compiling, linking, and running associated "read" software contained in the delivery package.
- Source code is run through code checker(s) to identify instances of non-compliance to coding standards and guidelines.
- Source code is compiled to check for programming errors.
- Scripts are checked for compliance to standards and guidelines.
- Test Plans are reviewed for completeness and the DAAC Management will convene an Inspection Review. If the Delivery Package is found to be complete, SSI&T continues. If there are deficiencies in the Delivery Package, these deficiencies are identified and brought to the attention of the MODIS SDP S/W Manager. Depending on the nature of the deficiency, the MODIS SDST will either provide minor changes to the Delivery Package or redeliver the entire package.

- Once the Delivery Package is complete and accepted by DAAC Management, it will be placed under CM.

3.3 Code Checking Utility and Compiler Execution

This section includes items such as the invocation method for the software compliance checking and compilation steps (i. e., via make files or scripts provided by the IT, or external to these via the DAAC), optimization versus non-optimization for initial compilation, etc. This information shall be supplied by the time the baseline documentation set for the Beta Release is published, (i.e., two months before the scheduled delivery date to the DAAC).

The SDST is planning to use the 32-bit option in the Silicon Graphics, Inc. (SGI) compiler for the Beta Release. Migrating to the 64-bit architecture will be deferred until V1.

3.4 Portability Issues

The SDST shall make every effort to follow the portability standards disseminated by the ESDIS Project. The Beta Release shall include some non-compliant features due to the prototype status of some of the STM-supplied code. In these cases, a waiver shall be issued from the ESDIS Project. The waivers currently approved for the Beta Release are the use of pmake and RATFOR in the Oceans software supplied by Miami and the use of obtained Integer *2 in FORTRAN to accommodate software supplied by the Atmospheres team. These waivers expire with the Beta Release; they do not carry over to the V1 and V2 releases. The SDST software acceptance and integration process, at a minimum, verifies the compilation of all code against the American National Standards Institute (ANSI) compiler option. Once the specific IR-1 hardware platform is known, issues concerning byte ordering, word size differences, and operating system differences between the TLCF and the GSFC DAAC shall be evaluated.

3.5 Redelivery Criteria

A number of specific criteria can be defined for re-transfer of portions (or the entire) of the delivery package from the MODIS TLCF, such as:

- Contents of the delivery do not match the description in the delivery message.
- Science software source code fails to comply with the ESDIS Project Data Production Software and Science Computing Facility Standards and Guidelines.
- Portions of the delivered code do not meet the pass/fail criteria identified in the test procedures.

3.6 Modification of Delivery Package Contents at the DAAC

The SDST is the only group that is permitted to modify the MODIS software. Any changes the DAAC personnel want made to the MODIS software must be evaluated and approved on a case-by-case basis by the MODIS Configuration Control Board (CCB). The CCB approval process is described in Section 3.8.

3.7 The Change Control Process Between the Science Computing Facility and the DAAC

The SDST shall use the Distributed Defect Tracking Systems (DDTs) for Software Problem Report (SPR) tracking and generation for the Beta software release. This choice is consistent with the recommendation from ESDIS Project. The ESDIS Project has selected DDTs as the defect tracking tool for the Release A system. If possible, the DAAC would have this tool available for SDST use during the infusion process.

The change control process for the V1 and V2 Releases of the SDP S/W are to be augmented by the use of ClearCase. The details of the SDST process are provided in the MODIS SDST Configuration Management Plan, document number SDST-004, which is available from the MODIS SDST CMO.

3.8 Establishment of Configuration Management

Each SDP S/W-supplied PGE will be a configuration item with a name and number assigned by the SDST CMO. The file naming convention(s) adopted by Science Processing support Office and Hughes for MODIS software processes, product files, and ancillary data shall be used. By the time the Beta code is delivered to the DAAC, SDST intends to begin using ClearCase to automate the configuration control and release of software. The SDST anticipates that the DAAC shall also be using ClearCase, and the SDST intends to model their CM procedures and processes after those used by the DAAC.

Once software is released to the DAAC, any change requests against the delivered software must first be placed in the DDTs and then be approved or rejected by the SDST CCB. A Software Configuration Change Request (CCR) Form generated by the SDST CMO based on the information in the DDTs will be used to initiate the CCB review. Any of the participants (SDST or DAAC) in the software infusion process may submit change requests to DDTs. During I&T of the Beta software release in the DAAC, no changes can be made without CCB approval.

Once the Beta Release has been accepted by the DAAC via a successful Software Acceptance Review, the DAAC CMO assumes responsibility for maintaining the configuration of the software system in the DAAC environment.

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4. POST HAND-OFF INTEGRATION AND TESTING AT THE DAAC

4.1 Inspection of the Delivery Package by the DAAC

The Delivery Package contents will be checked against the inventory listed in the Delivery Memo file contained in the Delivery Package. The files are cursorily checked for non-zero length and that they contain the information consistent with their label (e.g., data, documentation, text). Data files will be inspected to ensure that they contain the correct data types in the proper format(s). Documentation files will be checked for completeness and comprehensibility appropriate for the purpose and intent of the delivery.

Source code will be checked for compliance to SDP S/W standards with a code checker and then compiled with IT-specified compiler options to check for programming errors. All scripts contained in the delivery package will be checked for compliance with the MODIS Software Development Standards and Guidelines. Test plan(s) will be examined for completeness. The steps taken by the SDST in the infusion process for integrating the SDP S/W with the DAAC version of the SDPTK and subsequent testing performed by the SDST will be reviewed. The acceptance criteria for the delivery are identified on Section 4.5.

4.2 Inspection Review

At the conclusion of the inspection process an Inspection Review will be held. Participants in the Inspection Review include the SDST, DAAC management, SSI&T staff and other ESDIS Project representatives as necessary. The purpose of the review is to provide an assessment of the readiness of the SDP S/W to be integrated by the DAAC staff and to proceed with acceptance testing. Minimal evaluation criteria include the delivery of all files, clearly stated deviations from development and coding standards, documented processes performed during the infusion method and an assessment of the viability of the SDP S/W for further I&T. DAAC management will decide to proceed with SSI&T or stop the SSI&T process until critical deficiencies have been eliminated. As the delivery package passes the Inspection Review, the contents of the delivery package are placed under CM at the DAAC.

4.3 Integration and Test of SDP S/W with ECS at the DAAC

The SDP S/W may encounter different implementations, behavior, and peripheral components (e.g., testing tools) in the toolkit functions. The version of the SDPTK that runs at the SCF is identified as the SCF Toolkit and the version of the toolkit that runs at the DAAC is identified as the DAAC Toolkit. Within the SCF Toolkit there are two groups of software tools: mandatory tools, which the system requires in science software, with compliance-checking to occur during SSI&T at the DAAC; and optional tools, whose primary purpose is to save SCF development effort by reducing redundancy.

In the first phase of I&T the SDP S/W is linked with the SCF version of the toolkit on the DAAC hardware. Test results and output files are compared to expected test results and output files contained in the delivery package. Execution time per process and per PGE shall be recorded and compared with similar information recorded in the testing

phase at the TLCF. This step will give an indication of any hardware or system (compiler, OS) differences between the TLCF and the DAAC environments.

In the second phase of the I&T the SDP S/W is linked with the DAAC version of the toolkit on the DAAC hardware for further integration into the ECS environment. The MODIS SDST Integration Lead for the Beta Release shall work closely with the DAAC SSI&T personnel to incorporate the DAAC version of the toolkit. It is anticipated that the toolkit calls will not differ significantly between the TLCF and DAAC versions for the IR-1 system. If problems are encountered in linking to the DAAC toolkit that require changes to the delivered Beta Release software, the change control process described in Sections 3.6 and 3.7 shall apply.

4.4 Acceptance Testing

During the acceptance testing phase of SSI&T at the DAAC, the MODIS SDST-supplied Beta Release Test Plan will be executed to demonstrate the portability of the science software and to determine how well the SDP S/W interfaces and runs in the ECS Science Data Processing Segment (SDPS) environment at the DAAC. Results obtained at the SCF and during the infusion processes will be compared with results obtained from the DAAC during acceptance testing. Scripts supplied by the SDST will be run with the test data supplied in the delivery package. DAAC SSI&T personnel and SDST representatives will participate in the verification of test results. The acceptance testing process will include checking normal execution paths, error handling capabilities of the SDP S/W, and the ability to restart in the event of failure.

4.5 Acceptance Criteria

The acceptance criteria for the Beta Release shall consist of the successful duplication (within defined tolerances) in the DAAC of the tests run on the Beta Release at the TLCF. The tests, test data sets, and expected test results are described in the Beta Release Test Plan. The Beta Release Test Plan is part of the minimum documentation set required to accompany the delivery, and is described in greater detail in Section 2.1.5. An assessment of the production capability of the Beta Release software is not appropriate and shall not be performed.

4.6 Acceptance Review

DAAC SSI&T personnel will prepare a report documenting the input and output products ingested and produced, a log of testing procedures, and the results of acceptance testing. The acceptance test report will be reviewed by SDST representatives, DAAC management and SSI&T staff, and appropriate ESDIS Project representatives. Upon acceptance by DAAC management the SDP S/W will be transferred to operational processing (the Beta Release shall not be moved over to operations). If discrepancies in expected and actual results are encountered, the policies governing delta (patch) deliveries shall apply.

5. POLICIES GOVERNING DELTA (PATCH) DELIVERIES

This section describes the process by which intermediate science software deliveries are to be made. A delta delivery may occur for one of two reasons. A re-delivery of all or a portion of code to correct problem(s) found in testing and/or operations may be required. A delta delivery may also be made to upgrade the functionality of the software to include additional science software processes received after the original delivery date. This is separate and distinct from a re-delivery required to remedy delivery package and/or code compliance issues.

5.1 Requirements for a Delta Delivery

A delta delivery would occur at the mutual agreement of the SDST Manager and the DAAC SSI&T Manager. The documentation accompanying the delta delivery shall consist of updates to the delivery documentation described in Section 2.

5.2 Methods for Accomplishing a Delta Delivery

A delta delivery would be transferred to the DAAC in the same way as a normal delivery as described in Section 2. The same CM procedures would apply. Patches or upgrades to the delivered software shall always flow from the MODIS TLCF to the GSFC DAAC. Modifying software in the DAAC to install a patch is not the preferred method for carrying out a delta delivery and shall only occur with the consent of the SDST Manager, the DAAC SSI&T Manager, and the SDST R&QA Manager.

5.3 Delta Delivery Testing and Data Requirements

The delta delivery shall be accompanied by test procedures, data, and pass/fail criteria that serve to prove that any problems encountered in the previous delivery have been resolved. If the delivery is motivated by upgraded functionality, the necessary test procedures, data, and pass/fail criteria for testing the new functionality will accompany the delivery.

5.4 Delta Delivery Science Software Integration and Test

The delta delivery SSI&T activities shall follow the activities appropriate for that release as described in Sections 3 and 4.

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6. REGRESSION TESTING AT THE DAAC

Regression testing will be performed at the DAAC starting in the V1 delivery timeframe with delta deliveries of the SDP S/W. An issue to resolve is the ECS environment at the DAAC in the V1 delivery timeframe. The V1 delivery from the SDST to the DAAC will occur around the same time that ECS Release A is available at the DAAC. Final schedules need to be obtained from ESDIS Project and ECS to better understand the deliveries of the ECS to the DAAC. The DAAC will develop a regression test plan with input from the MODIS SDST. Part of the test plan will include the role of the SDST and the DAAC in the disposition of problems encountered during regression testing.

6.1 Tools for Regression Testing

Regression testing will make use of SSI&T tools on testing and reporting. These tools include:

- The capability to display documentation in any of the following formats: Hyper-Text Markup Language (HTML), American Standards for Character Information Interchanges (ASCII), Postscript, Rich Text Format (RTF) and Text (txt).
- The capability to read ASCII, binary, or Hierarchical Data Format (HDF) files.
- The code checking capability to determine if science software source code complies with the ESDIS Project Data Production Software and Science Computing Facility Standards and Guidelines.
- The capability to generate report files describing the results of standards checking, code analysis and regression testing.
- The capability to perform interactive debugging.
- The capability to process make files.
- The capability to difference data and produce 2- or 3-dimensional images or plots such as Mosaic, Collage, or Sentinel.
- The capability to determine if the science software contains memory leaks.
- The capability to determine if the science software contains unused code.
- The capability to generate profiling statistics (CPU, memory usage, disk space usage, I/O accesses) at the process level and to generate report files describing the results of the profiling activities.
- The capability to display a list of files that comprises an operator-specified algorithm.
- The capability to display a list of PGEs in the PGE database and to display the contents of the PGE database for an operator-specified PGE.
- The access to a CM tool (ClearCase).
- The access to a problem-tracking tool (DDTs).
- The capability to keep a running log of SSI&T activities on-line.
- The following utilities will be installed: csh, emacs, ksh, lex, make, man, perl, posix-compatible script language, tar, vi, yacc, and zip gnu.
- The capability to access e-mail, World Wide Web browse, USENET access, gopher client, and WAIS client.

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APPENDIX A: ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
ASCII	American Standards for Character Information Interchanges
BRDF	Bi-directional Reflectance Distribution Function
CCB	Configuration Control Board
CCR	Configuration Change Request
CM	Configuration Management
CMO	Configuration Management Officer
CPU	Central Processing Unit
CSMS	Communication and System Management Segment
DAAC	Distributed Active Archive Center
DDTs	Distributed Defect Tracking System
ECS	EOSDIS Core System
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESDIS	Earth Science Data and Information System
GSC	General Sciences Corporation
GSFC	Goddard Space Flight Center
HDF	Hierarchical Data Format
HTML	Hyper-Text Markup Language
ICD	Interface Control Document
I&T	Integration and Test
IT	Instrument Team
L1A	Level 1A
L1B	Level 1B
L2	Level 2
L3	Level 3
L4	Level 4
MCST	MODIS Characterization Support Team
MODIS	Moderate Resolution Imaging Spectroradiometer
PGE	Product Generation Executive
QA	Quality Assurance

APPENDIX A: ACRONYMS AND ABBREVIATIONS (CONTINUED)

R&QA	Reliability and Quality Assurance
RTF	Rich Text Format
SCF	Science Computing Facility
SDP	Science Data Production
SDPS	Science Data Processing Segment
SDP S/W	Science Data Production Software
SDPTK	Science Data Production Toolkit
SDST	Science Data Support Team
SGI	Silicon Graphics, Inc.
SPR	Software Problem Record
SSI&T	Science Software Integration and Test
SS/W	Systems Software
STM	Science Team Member
TLCF	Team Leader Computing Facility
tex	Text
V1	Version 1 of the MODIS data processing software
V2	Version 2 of the MODIS data processing software

APPENDIX B: SSI&T MATRIX FOR SDST SDP S/W BETA RELEASE

	#	Step Description	DAAC Responsibility	SCF Responsibility	ECS/ESDIS Responsibility
NOTE: The 'G' in column 1 represents the mandated ESDIS Project requirements.					
G	1	The MODIS R&QA Manager shall notify the DAAC and ECS/ESDIS Project of their intention to conduct SSI&T, providing an Operations Support Request with information regarding the time frame, size and scope of the delivery, etc. This should occur at least 14 days in advance of the planned delivery date for Beta delivery.		E-mail to DAAC; Develop Test Plan with estimated resource requirements and expected machine utilization (CPU, disk, network).	
G	2	The DAAC responds with an assessment/ approval of the SCF's stated intentions and requirements, and includes information such as delivery directory name(s). If significant issues and/or problems arise, a dialogue is engaged for their resolution. ECS/ESDIS Project schedules SSI&T support personnel, based upon the dialogue with the SCF and the DAAC.	Respond to TLCF (cc: ESDIS Project/ECS and MODIS SSM within ESDIS) within 7 days on staffing and potential machine limitations (CPU, disk, network).		Address potential resource limitations, including staffing.
	3	Confirmation of and/or refinements to the planned delivery schedule are provided to the DAAC (cc: ECS/ESDIS Project) by the MODIS SDST R&QA Manager. This should occur approximately 7 days in advance of the intended delivery, and whenever conditions warrant.		E-mail to ESDIS Project/ECS and DAAC.	
	4	Receipt of delivery confirmation message is acknowledged by the DAAC.	E-mail sent to SDST Leader and SDST CMO.		

	#	Step Description	DAAC Responsibility	SCF Responsibility	ECS/ESDIS Responsibility
G	5	A complete delivery package, including a Delivery Memo, is transferred to the DAAC in the previously specified transfer directory.		Explore feasibility of exporting CM files from common tool used by DAAC and SDST.	
	6	The System Software (SS/W) development team provides notification that the delivery has been made (cc: ECS/ESDIS Project). CM tool may present additional information being exchanged/delivered.		Manage CM process at DAAC during infusion process. Review packing list and contents of delivery package.	
	7	The DAAC notifies the SCF of receipt of the delivery package.	At conclusion of Infusion Process (Hand off)		
G	8	The delivery package is examined for completeness.	Delivery (Hand off)	Infusion	
	9	A message is sent to the SCF containing information on the status of the essential contents of the delivery package.	Delivery (Hand off)	Infusion	
G	10	Source code files are examined utilizing standards checking utilities to verify compliance to coding standards and to identify potential cross-platform compatibility issues. Assessment is made as to which (if any) instances of non-compliance are potential "show-stoppers" and which should simply be noted while allowing the SSI&T process to continue.	Delivery (Hand off)	Infusion	
G	11	All source code modules are compiled.	Delivery (Hand off)	Infusion	
G	12	DAAC sends message stating its' acceptance/rejection of package, noting key items of interest and discrepancies (if any). Action to ameliorate delivery package problems are suggested.	Delivery (Hand off)		

	#	Step Description	DAAC Responsibility	SCF Responsibility	ECS/ESDIS Responsibility
	13	Depending upon assessments made by all involved parties, SS/W development personnel may elect to either fix delivery package problems at the DAAC (and communicate required changes back to the SCF), or fix the problems at the SCF and re-transfer specific portions of the delivery package. If desired, the delivery package can be re-transferred in its entirety.		Infusion	
	14	Upon acceptance of the basic contents of the delivery package, all items in the package are placed under configuration control, with a PGE-oriented CM scheme. A key aspect of the CM process is to ensure that any modifications to the delivery package made in the DAAC environment are properly communicated and similarly executed (as required) at the SCF.	DAAC takes over CM on delivery.	Transfer CM information to DAAC.	
	15	The software is linked to the appropriate libraries and SCF-version of the SDPTK.		Infusion	
	16	The test matrices for the individual PGEs are executed with results compared to expected results.		Provide Infusion results from SCF Toolkit linkage to DAAC for comparison.	
	17	The product and metadata output is compared with the expected test output data included in the delivery package.	After Delivery (Hand off) compare test results with expected results.	Test results from Infusion process are provided to DAAC.	
G	18	The software objects are linked with the DAAC version of the SDPTK which includes links to the Planning and Data Processing Subsystems.	Delivery (Hand off)	Infusion	

	#	Step Description	DAAC Responsibility	SCF Responsibility	ECS/ESDIS Responsibility
G	19	The test matrices for the individual and multiple PGEs are executed.	Delivery (Hand off)	At the completion of Infusion, preliminary test results are forwarded to the DAAC for comparison with files created after Hand off.	
G	20	The product and metadata output is compared with the expected test output data included in the delivery package.	Delivery (Hand off)	Infusion	
	21	Profiling statistics in the test matrix are compared with those measured at the SCF.	Delivery (Hand off)	Infusion	
	22	The source code is compiled using the appropriate optimization parameters and is linked with the appropriate libraries including the DAAC version of the SDPTK.	Tested after Delivery (Hand off) Repeat steps 19-21.	Initially completed in the infusion process. Note: Compatibility and proper settings for optimization, profiling and debugging must be checked.	
G	23	Science software testing is performed using SCF-supplied simulated input data.		This is part of the delivery package in Beta.	
	24	The DAAC arranges a Software Acceptance Review, inviting all parties to attend. The review should cover: 1) Brief history of problems associated with delivery, building, testing, etc. 2) Results of comparison of test output data with test data included in the delivery package.	X	X	X

	#	Step Description	DAAC Responsibility	SCF Responsibility	ECS/ESDIS Responsibility
	24	(Continued) 3) Results of testing/ product verification by SCF personnel. 4) Comparison of profiling measurements between DAAC and SCF version of SS/W. 5) Criteria for acceptance/rejection of the software package in its current form. 6) Where to go from here? (Beta turnover target date: 5/31/96).	X	X	X

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APPENDIX C: SSI&T MATRIX FOR SDST SDP S/W VERSION 1 RELEASE

Version 1 SSI&T matrix schedule to be supplied by July 1996.

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**APPENDIX D: SSI&T MATRIX FOR SDST SDP S/W VERSION 2
RELEASE**

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